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THE CANADIAN SPECIES OF *EXEMA* AND *ARTHROCHLAMYS* (COLEOPTERA, CHRYSOMELIDAE)*

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The present paper is the result of a study of the food plant relationships of *Exema* Lac. and *Arthrochlamys* Ihering (*Chlamys* Knoch) in Canada. The study has shown that the species have strong monophagous tendencies, and that a knowledge of food plants is the key to an understanding of those which have been confused under the names *Chlamys gibbosa* and *C. plicata*. Both genera occur in southern Canada from Manitoba eastward; two species of *Exema* and six of *Arthrochlamys* are known from the Dominion. The species of both genera are unusual in many ways, and those of *Arthrochlamys* have some interesting sexual characters. In *Arthrochlamys bebbianae* n. sp., the aedeagus is apparently strongly dimorphic. *A. alni* n. sp. evidently exists entirely without males, and *A. eubati* n. sp. seems to occur sometimes without that sex. Other species show odd sex ratios.

LIFE HISTORIES

Notes have been published on the case-bearing habits and life histories of both *Exema* (9, 20) † and *Arthrochlamys* (3, 11, 21, 22, 23). All species of *Arthrochlamys* of the Ottawa district appear to have similar life histories. The adults hibernate and are seen first during late April or early May. Newly hatched larvae of *A. eubati* have been found in the district as early as May 27. During the same year, oviposition by this species reached its height at the end of the first week of June, and the larvae began to mature in numbers during the last week of July. In the laboratory, adults emerge about three weeks after the larvae have closed their cases, and in the field healthy pupae of *A. bebbianae* and *A. alni* can be found as late as the second week of September. Newly emerged adults are fully colored and heavily sclerotized. While adults can be found throughout the season, they become scarce during midsummer. There is evidently a single generation each year. Field observations suggest that the life history of *Exema canadensis* Pierce is similar to that of the species of *Arthrochlamys*.

The species of *Arthrochlamys* are frequently heavily parasitized by *Tetrastichus* Hal. The following parasites, determined by Dr. O. Peck and Mr. G. S. Walley, were reared from mature cases during the course of the present study: *Hemiteles tenellus* (Say) from *A. bebbianae* and *A. alni*; *Eupelmella vesicularis* (Retz.) from *A. bebbianae*; *Eurytoma* sp. from *A. chamaedaphnes*; *Tetrastichus* sp. from all of the Canadian species of *Arthrochlamys*; *Spilochalcis* sp., probably *albifrons* (Walsh), from *A. alni*, *A. bebbianae*, and from *Exema canadensis*.

FOOD PLANTS

Larvae of *Exema* have been reported only from species of Compositae. They have been found on *Hymenoclea monogyra* T. & G. in Arizona (4) and on *Artemisia californica* Less. in California (20). Beutenmuller (2) reared species that he identified as *E. gibber* (Fab.) and *E. conspersa* (Mann.) on

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†See also Jenks, G. E. Dwarfs that live in their hats. *Nature Magazine*, 33:337-340. This paper, dealing with *Exema jenksi* Pierce, was received at Ottawa on June 10, 1940, and therefore antedates Pierce's description of the species (20) which was issued on June 15 and received at Ottawa on June 26, 1940.

Aster sp. Under the name *gibber*, Chagnon (6) has reported *E. canadensis* on goldenrod in Quebec. Larvae of *canadensis* occur commonly on *Solidago* in the Ottawa district, but I do not know to what extent the species restricts its feeding. Larvae of *canadensis* are inclined to wander when ready for pupation. Consequently the pupae may be found occasionally on plants of any species growing in infested patches of *Solidago*.

Except for *eubati*, the Canadian species of *Arthrochlamys* appear to be monophagous. The habit is especially noteworthy in the case of *A. bebbianae* which sometimes forms rather populous colonies. The food plant, *Salix Bebbiana* Sarg., grows in association with other species of willow, but I have found neither adults nor larvae on these other species. Nor have I been able to associate *A. cribripennis* Lec. with any of the ericaceous plants that grow in association with its food plant, *Vaccinium angustifolium* Ait. *A. eubati* feeds on several species of *Rubus* L. belonging to the subgenus *Eubatus* Focke, but it avoids species belonging to other subgenera. In the Ottawa district, *Rubus odoratus* L. and *R. idaeus* L. were found entirely free of the beetle even when growing with species of *Eubatus* that were rather heavily infested with larvae. The economic entomologists at Ottawa have no record of the occurrence of *Arthrochlamys* on cultivated species of *Rubus* in any part of the Dominion. When the food plant of *A. chamaedaphnes* n. sp. was discovered, no immature individuals were available for rearing. The observed feeding of adults as well as the abundance of adults, empty pupal cases, and parasitized pupae on the food plant, *Chamaedaphne calyculata* (L.) Moench., which grew in large, virtually pure stands on sphagnum, proved the correctness of the association. Larvae of *A. comptoniae* n. sp. were found rather commonly on *Comptonia peregrina* (L.) Coulter at Tabusintac, N. B., but nearly all were parasitized. *A. alni* is less gregarious than the other species and occurs rather generally, but usually sparingly, on its food plant, *Alnus incana americana* Regel.

Under various names, usually *Chlamys plicata* or *C. gibbosa*, eastern species of *Arthrochlamys* have been reported from a number of food plants. Ericaceous records are *Vaccinium pennsylvanicum* Lam. in Maine (19), "huckleberry" in New Jersey (24) and Pennsylvania (12), and "low whortleberry bushes" in Massachusetts (14). Raspberry has been reported a food plant in Minnesota (16) and Ontario (17), but I suspect that these records are erroneous. Blackberry has been noted in Quebec (6), Ontario (13), New York (3, 15), Illinois (11), and Minnesota (16), and "*Rubus villosus* var. *humifusus*" in Ontario (10). Other authors have noted the occurrence of the beetles on *Rubus* (2, 8, 18, 22, 24). Alder has been recorded in Maine (18) and New York (3), and willow (18) has been reported as a food plant. Scudder (23) reared *Arthrochlamys* on sweet fern in Massachusetts, and the same food plant has been recorded by others (8, 18). Marlatt (21) found a species injuring sycamore in Kansas, and Beutenmuller (2) bred a species on hazel. *A. tuberosa* (Knoch) was reported by its author to occur on the chinquapin. Others have recorded the beetles from sycamore (22), *Quercus* L. (8, 18, 22, 24), *Betula alba* L. (8, 18), and *Amorpha canescens* Pursh. (5).

CHARACTERS

The species of *Exema* are closely allied to those of *Arthrochlamys*, and the genera have been distinguished in the literature by an unsatisfactory antennal character only. However, the Canadian species, together with their closest allies of the United States, fall into two natural groups which at present may be considered genera. Strong group characters are found in the aedeagus. In each genus, the general form of the aedeagus and the structure of its median orifice and of the sclerotized organ of its internal sac are characteristic. It is noteworthy that the form of the tarsal claws is not constant in *Exema*. In at least two species, *E. canadensis* Pierce and *E. neglecta* Blatch., the claws are simple, but they are appendiculate in *E. pennsylvanica* Pierce and in all Californian

specimens of *Exema* and in all species of *Arthrochlamys* that are known to me. The species of *Arthrochlamys* are difficult to separate by description. Each shows some variation in sculpture, in the form of the elytral tubercles, and in the cleft of the pronotal gibbosity. Some species show great variation in color. In the descriptions below, metallic brown shades are said to be bronze when they lack reddish reflections; when such reflections are present, they are described as copper-colored. In *Arthrochlamys* specific differences are found in the form of the apex of the aedeagus and in the form of the flagellum. Because the aedeagus is transparent, the flagellum can be observed in situ in balsam mounts. It is a sclerotized, elongate, paired structure. Its proximal end is obliquely truncate, and the entire truncation is occupied by an opening that is referred to as the basal orifice in the descriptions below. In males of *Exema*, each anterior and middle tibia is supplied, on the inner side at the apex, with a minute, spur-like process which projects inwardly. Females of *Exema* lack these processes. In *Arthrochlamys* such processes occur in the males and also in females of some species. In males of most species of *Arthrochlamys*, each anterior tibia is supplied with two such processes. These tibial processes are difficult to observe, but they are sometimes very useful in separating species.

Other secondary sexual characters are well developed in both genera. In males of both, the antennae are considerably larger than in females, and the body is a little smaller and, in *Arthrochlamys*, is more strongly narrowed behind. In males the last ventral segment is flattened at the middle; in females this segment is broadly concave, strongly so in *Arthrochlamys*, scarcely so in *Exema*. In males of *Exema*, there is a minute tooth on each side of the median line on the first two or three abdominal segments. The form of that portion of the abdomen between the elytron and the cavity which receives the posterior femur varies somewhat in each species of *Arthrochlamys*, but it is always much narrower and more nearly parallel in males than in females in that genus. In *Arthrochlamys* the middle femora differ in form in the sexes, and the pygidium is usually less strongly alutaceous and therefore more strongly shining in males than in females. In *A. cribripennis*, *A. comptoniae*, and *A. plicata*, the form of the prosternal plate differs in the sexes.

The cases of the larvae offer little in the way of characters. In *Exema canadensis*, the mature case terminates above in a very well developed nipple which inclines at a strong angle from the axis of the case. In some mature cases of *Arthrochlamys*, the nipple is evident as a short, inclined, blunt point, but usually it is destroyed by erosion and the case is then variably rounded at the tip. The well developed nipple of *Exema* may be a generic character, as it is figured for a Californian species by Pierce (20) and for a Mexican species by Dugès (9). In *A. bebbianae* the case has a grayish cast and, in part at least, a pubescent surface not seen in our other species. This is due to the tomentum of the leaf of the food plant, which becomes incorporated into the case.

NOMENCLATURE

Our species of *Exema* are referred to *canadensis* Pierce and *pennsylvanica* Pierce, not because they satisfy the descriptions perfectly, but because they are the only species known to me to which the descriptions can apply. Unless cryptic species exist in *Exema*, the color characters, which are covered by Pierce's descriptions, define each species adequately enough for recognition. Moreover, only the one species is known to occur near Montreal, the type locality of *canadensis*. Although he found it impossible to recognize *E. dispar* Lac., Pierce described *canadensis* as a subspecies of the former. Such procedure is, of course, not permissible. The color characters of *canadensis* are unlike those given in the description of *dispar* (1848, Mem. Soc. Roy. des Sci. Liège, 5:850) which would apply best to a species smaller in size but otherwise much like *E. neglecta* Blatch.

The Canadian species of *Arthrochlamys*, with the exception of *cribripennis*

Lec., belong to the extremely difficult group of forms that have been confused under the name *Chlamys gibbosa* or *C. plicata*. My determination of *cribripennis* is based on the description and on a comparison with the type made by Dr. P. J. Darlington, Jr.* The following six names have been validated for North American species of the *plicata* complex.

Bruchus gibbosus Fabricius, 1777, *Genera Insectorum*, p. 212. Type locality: North America.

Clythra plicata Fabricius, 1798, *Supplementum Entomologiae Systematicae*, p. 111. Type locality: "Carolina".

Chlamys tuberosa Knoch, 1801, *Neue Beyträge zur Insectenkunde*, Leipzig, p. 128, tab. 4, fig. 1, 2. Type locality: North America. As the type was received from Melsheimer, it probably came from Pennsylvania. The species was said by Knoch to live on the chinquapin (probably *Castanea pumila* (L.) Miller).

Chlamys assimilis Klug, 1824, *Entomologische Monographien*, Berlin, p. 239. Validated as a new name for *affinis* Klug (op. cit., p. 115), not Kollar. Type locality: North America.

Chlamys tuberculata Klug, op. cit., p. 117, tab. 8, fig. 1. Type locality: "Savannah".

Chlamys polycocca Lacordaire, 1848, *Mem. Soc. Roy. des Sci. de Liège*, 5:704. Type locality: The United States.

I have been able to identify none of these species. The collections at hand show that several species of the complex, other than those described below, occur in eastern United States. For these reasons, I am describing all of the Canadian species as new. However, there is a large blackberry-feeding species that is common in the Carolinas. On the basis of locality alone, it is possible that this is *plicata* (Fab.). It is included below under that name for comparison with the Canadian species.

Keys to North American species of *Arthrochlamys* have been published by Linell (1898, *Proc. U. S. Nat. Mus.*, 20:476-480) and by Schaeffer (1906, *Mus. Brooklyn Inst. Sci. Bull.* 1, 227-230; 1926, *Proc. Ent. Soc. Washington*, 28:181-187), and a catalogue of the species of both genera has been published by Achard (1).

KEY TO SPECIES

1. Not metallic; black, usually with the pronotum, front, or legs marked with yellow. Length less than 3 mm. (*Exema* Lac.) 2
2. Metallic; the color variable but never black; body never with yellow markings except for the labrum and for a spot, often lacking, within the emargination of each eye. Length usually greater than 3 mm. (*Arthrochlamys* Ihering) 3
2. Pronotum with yellow markings; its punctures circular, dense, and moderately coarse; its sculpture not at all strigose. Elytra usually with yellow spots. Tarsal claws appendiculate 1. *E. pennsylvanica* Pierce.
- Pronotum entirely black; its punctures fine, elongate, their form and arrangement producing a substrigose sculpture. Elytra always entirely black. Tarsal claws simple. Occurring on glodenrods, *Solidago* spp. 2. *E. canadensis* Pierce.
3. Prosternal plate feebly emarginate on each side and therefore subtriangular. First abdominal segment with moderately coarse punctures. Pronotal gibbosity shallowly divided. Size small, the males measuring 2.7 to 2.8 mm. Color nearly always a deep coppery red. Occurring on a blueberry, *Vaccinium angustifolium* Ait. 3. *A. cribripennis* (Lec.).
- Prosternal plate more deeply emarginate on each side and therefore goblet-shaped. First abdominal segment lacking discrete punctures; with large, very shallow, poorly defined foveae in addition to the usual alutaceous sculpture. Pronotal gibbosity more deeply divided. Size larger 4.

*I am indebted to Doctor Darlington for this favor, and also to Dr. Roger C. Smith and to Messrs. O. L. Cartwright, G. Chagnon, C. A. Frost, and G. Stace Smith, who have supplied me with material from their collections.

4. Apical ventral segment and pygidium finely vermiculate, the pygidium sparsely punctate. Body bronze, the elytra always concolorous. Occurring on blackberries (*Rubus* L.) of the subgenus *Eubatus* Focke.....5. *A. eubati* n. sp.
- Apical ventral segment usually roughly sculptured but never vermiculate. Pygidium alutaceous and sparsely punctate; its surface usually irregular, often with elevated, smoother areas on each side of the median line, but never vermiculate.....5.
5. Abdomen with the apical segment sculptured like the first. Size larger, the length 4 mm. or more. Prosternal plate differing in the sexes, the male differing from both sexes of all the other species in having the sides of the prosternal plate between the middle coxae strongly elevated and deeply serrate. Occurring on blackberry in southern United States.....6. *A. plicata* (Fab.).
- Abdomen with the sculpture of the apical segment deeper, rougher, and more dense than that of the first segment. Size smaller, the length usually a little less than 4 mm. Occurring in eastern Canada.....6.
6. Species with the elytra dull or only moderately shining. Females with each front and middle tibia supplied with a small, inwardly projecting, spur-like process on the inner side at apex.....7.
- Species with the elytra strongly shining.....8.
7. Females only. Body entirely bronze, the color constant. Occurring on the speckled alder, *Alnus incana americana* Regel.....7. *A. alni* n. sp.
- Males and females. Rarely bronze; nearly always with the body copper-colored and the elytra purple or dark blue. Occurring on a willow, *Salix Bebbiana* Sarg.....8. *A. bebbianae* n. sp.
8. Strigose sculpture of the pronotum and elytra finer. Length of males 3.2 to 3.6 mm., of females 3.5 to 3.8 mm. Males differing from those of all of the other species of *Arthrochlamys* in having a single spur-like process on the inner side of each anterior tibia at apex; females with a small process on each anterior and middle tibia. Occurring on the leather leaf, *Chamaedaphne calyculata* (L.) Moench.....9. *A. chamaedaphnes* n. sp.
- Strigose sculpture of the pronotum and elytra relatively coarse. Average size smaller, the males measuring 3.0 to 3.2 mm., the females 3.4 to 3.6 mm. Males with two approximate, spur-like processes at the apex of each anterior tibia; females lacking tibial processes. Occurring on the sweet fern, *Comptonia peregrina* (L.) Coulter.....4. *A. comptoniae* n. sp.

1. *Exema pennsylvanica* Pierce

Exema pennsylvanica Pierce, 1940, Bull. Southern California Acad. Sci., 39:18, pl. 2, fig. 4.
Exema conspersa of authors, in part.

Length of males 2.2 to 2.4 mm., of females 2.5 to 2.6 mm. Black; the antennae yellow, sometimes darker apically; legs bicolored, sometimes largely yellow, the femora in part and large subapical and sub-basal areas of the tibiae yellow, tarsi always yellow; anterior declivity of the pronotum with a yellow area, this variable in size and irregular in form, extending from the anterior pronotal margin halfway to the summit of the gibbosity, usually about as wide as the front between the antennae except on the anterior pronotal margin where it is wider; the pronotal disk usually with a few small yellow spots; these sometimes larger, more numerous, and attached in part to the median yellow area; elytra usually with a few yellow spots, these sometimes numerous; head of male largely yellow; the yellow area not quite attaining the labrum and antennal grooves, wider above where it attains the upper lobes of the eyes and sometimes invades the ocular emarginations, sometimes divided by a small black area on the median line at the pronotal margin; head of female with the markings greatly reduced, usually with a longitudinal band adjacent to the upper lobe of each eye, an elongate spot at middle, and a small spot within each ocular emargination yellow.

Pronotal disk not at all strigose, the punctures dense, circular, coarser than in *canadensis*. Elytral punctures closer and sculpturing the elytra more roughly than in *canadensis*.

Prosternal plate with the anterior portion about as wide as long, the posterior portion slender; not with the anterior portion strongly transverse and the posterior portion stout as figured by Pierce; more abruptly narrowed at middle, otherwise as in *canadensis*. Apical segment of the abdomen with the punctures not transverse, coarser than in *canadensis*. Tarsal claws appendiculate.

Other characters as in *canadensis*.

Food plants unknown.

The collection contains eleven specimens from St. Louis, Mo., and north-eastern Kansas as well as a single specimen from "W. Ont.", a label used by early collectors to designate the portion of Ontario that is situated southwest of the Georgian Bay and Toronto regions. The species is probably restricted in Canada to this area.

In males of *E. neglecta* Blatch., a species of southern United States, the pronotum is marked with yellow much as in *pennsylvanica*. In *neglecta*, however, the tarsal claws are simple, the pronotal punctation is more like that of *canadensis*, and the size is larger. The Californian specimens which are usually referred to *E. conspersa* Mann. differ from specimens of *pennsylvanica* in having the pronotal gibbosity less strongly elevated and the body above nearly always more heavily maculate with yellow.

2. *Exema canadensis* Pierce

Exema dispar canadensis Pierce, 1940, Bull. Southern California Acad. Sci., 39:10, pl. 2, fig. 2.

Exema conspersa of authors, in part.

Exema gibber of Canadian authors.

Length of males 2.3 to 2.5 mm., of females 2.5 to 2.7 mm. Moderately shining; black; antennae yellow, darker in apical half; labrum yellow; each tibia annulate before the base and apex with yellow, these tibial markings sometimes lacking entirely or in part; femora sometimes marked with yellow, tarsi brown, rarely brownish yellow; head of male with a large, triangular, anterior area and a longitudinal band adjacent to the upper lobe of each eye yellow, the bands nearly always joining the apex of the yellow triangle at the middle of the head, the triangle never quite attaining the labrum or the antennal grooves; head of the female with the markings greatly reduced or entirely lacking, usually with a yellow spot or band adjacent to the upper lobe of each eye and with a small yellow spot at middle.

Pronotal gibbosity feebly and broadly sulcate at the summit; the carina limiting the sulcus on each side more or less irregular, extending halfway to the anterior pronotal margin; the posterior declivity of the gibbosity limited above by three more or less transverse tubercles on each side. Punctures of the pronotum fine, elongate, giving the pronotum a substrigose sculpture. Elytra with the usual tubercles, the punctures between them coarse. Prosternal plate much less abruptly narrowed at middle, and the narrow, posterior portion much shorter than figured by Pierce. Metasternum coarsely and densely punctate. First abdominal segment densely punctate, the punctures less coarse than those of the metasternum; the apical segment with the punctures very close, transverse. Tarsal claws simple.

Food plants: goldenrods, *Solidago* spp.

The collection contains a large number of specimens from French Lake and Bathurst, N. B., Montreal, Que., the Ottawa district, the Lake Erie district of Ontario, Natick and Framingham, Mass., and Clemson College, S. C.; twenty-six of the Ottawa district specimens were reared from larvae and pupae taken on *Solidago*. The female of *E. neglecta* Blatch. is very similar to that of *canadensis* but is a little larger and has the pronotum a little more roughly sculptured.

3. *Arthrochlamys cribripennis* (Lec.)

Chlamys cribripennis LeConte, 1878, Proc. Amer. Philos. Soc., 17:614. Linell, 1897, Proc. U. S. Nat. Mus., 20:479. Schaeffer, 1906, Mus. Brooklyn Inst. Sci. Bull. 1, 229.

Boloschesis cribripennis (LeConte), Schaeffer, 1926, Proc. Ent. Soc. Washington, 28:183.

Size small, the males measuring 2.7 or 2.8 mm., the females 3.1 to 3.3 mm. Rather strongly shining; usually a deep coppery red, sometimes copper-colored; sometimes with a more or less obscure yellow spot within the emargination of each eye; labrum dark at middle, yellowish on each side; antennae usually entirely yellow, the apical segments sometimes a little darker. Pronotum with the gibbosity very shallowly divided; the disk sparsely, very finely punctate, the punctures very indistinct except on the sides where the strigae become obsolete. Elytra with the tubercles as in *comptoniae*, less strongly developed than in the other species; the juxta-scutellar tubercles usually not or scarcely evident; the elytral punctures a little closer in the male than in the female; the strigulose sculpture feebly impressed, very fine but quite evident.

Posternal plate feebly emarginate on each side and therefore subtriangular, more broadly triangular in the female. Metasternum with very close, coarse, well defined and moderately deep punctures. Abdomen with close, moderately coarse punctures; these shallow, well defined except on the sides of the first segment, deeper and confluent in part on the apical segment. Pygidium punctate and more or less alutaceous. Abdominal concavity of the female less strongly developed than in the other species. Each anterior tibia of the male with two equal, spur-like processes on the inner side at apex, these separated by a V-shaped space; each middle tibia with a single, similar process; the tibiae of the female lacking processes.

Aedeagus (fig. 1), viewed dorsally, with the apex subtruncate, the extreme apex acutely pointed but strongly deflexed and therefore not evident in that aspect, the species differing in this respect from all of the others except *comptoniae*; flagellum relatively longer than in the other species, its length equaling 80 to 84 per cent of the length of the portion of the aedeagus distal to the submedian constriction; basal orifice of the flagellum occupying 30 to 36 per cent of the flagellar length.

Food plant: a blueberry, *Vaccinium angustifolium* Ait. (= *Vaccinium pennsylvanicum* of some authors).

The type of this, the most strongly characterized of our species, was taken at Detroit, Mich. The species is represented in our collection by eighteen males and forty females from Brockville, Ont., Duparquet, Que., and from the following localities of the Ottawa district: Kazubazua, Que., and Constance Bay, Blackburn, and South March, Ont. Most of the specimens were swept from the blueberry at Constance Bay, and among these are seven that were taken as larvae and reared on that plant.

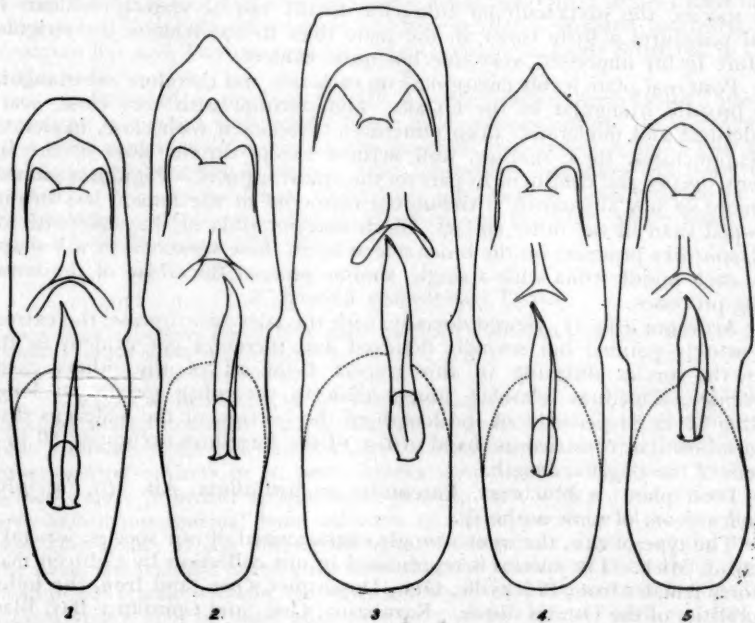
4. *Arthrochlamys comptoniae* n. sp.

Length of males 3.0 to 3.2 mm., of females 3.4 to 3.6 mm. Strongly shining above; copper-colored; the labrum, antennae, and sometimes a spot within the emargination of each eye yellow. Pronotum with the gibbosity wide as noted in the description of *bebbianae*; the strigose sculpture coarse as in *cribripennis* but more strongly impressed, coarser than in the other species; each side of the pronotum with sparse punctures that are evident only in certain lights. Elytra with the tubercles as in *cribripennis*, less strongly developed than in the other species, the juxta-scutellar sometimes lacking; the strigulose sculpture very distinct, coarser than in the other species. Prosternal plate goblet-shaped, its anterior portion relatively wider in females than in males. Punctures of the metasternum dense, very large, shallow but well defined. Abdomen subrugose; the sculpture subfoveiform, irregular, rough but shallow, deeper on the apical segment where it takes the form of transversely confluent punctures. Pygidium punctate and more or less subrugose. Each anterior tibia of the male with two

equal, approximate, spur-like processes and each middle tibia with a single process as in most of the other species; the tibiae of the female lacking processes.

Aedeagus with the acutely pointed apex strongly deflexed much as in *cribripennis*; viewed dorsally, the apical angle evident on a lower plane in some specimens, not evident in others, the apex in these appearing subtruncate or broadly rounded in that aspect; characters otherwise as in the holotype of *bebbianae*; the flagellar length equaling 55 to 65 per cent of the length of the portion of the aedeagus distal to the submedian constriction; basal orifice of the flagellum occupying 35 to 40 per cent of the flagellar length.

Food plant: the sweet fern, *Comptonia peregrina* (L.) Coulter (= *Myrica asplenifolia* of authors).



Aedeagi of species of *Arthrochlamys*. 1, *A. cribripennis* (Lec.). 2, *A. eubati* n. sp. 3, *A. plicata* (Fab.). 4, Holotype of *A. bebbianae* n. sp. 5, Morphotype of *A. bebbianae* n. sp.

Holotype: ♂, Natick, Mass., Aug. 8, 1942, on sweet fern (C. A. Frost); No. 5407 in the Canadian National Collection, Ottawa.

Allotype: ♀, same data.

Paratypes: 3 ♂, 15 ♀, Natick, Mass., July 24 and 26, Aug. 8, and Sept. 6, 1942, on sweet fern (C. A. Frost); 8 ♂, 6 ♀, Sherborn, Mass., May 30, 1942, swept from sweet fern (C. A. Frost); 1 ♂, Tabusintac, N. B., 1939, reared from larva on *Comptonia peregrina* (W. J. Brown); 1 ♂, Tabusintac, N. B., Aug. 2, 1939, swept from *Comptonia peregrina* (W. J. Brown).

This species is characterized by its small size, the shining, copper-colored integument, the relatively coarse strigulose sculpture of the pronotum and elytra, the sexual difference in the prosternal plate, and by the strongly deflexed apex of the aedeagus.

5. *Arthrochlamys eubati* n. sp.

Males rare. Length of males 3.6 mm., of females 3.8 to 4.1 mm. Rather strongly shining; bronze, the color constant; labrum, antennae, and a spot within the emargination of each eye yellow, the antennae usually darker apically, the

spot of the emargination always present. Pronotum impunctate or virtually so, a few specimens with a few punctures evident on each side in certain lights; the pronotal characters as noted in the description of *bebbianae*. Elytra with the juxta-scutellar tubercles always very feeble, the other tubercles well developed; the strigulose sculpture a little coarser than in *bebbianae* and *alni*.

Frosternal plate goblet-shaped; metasternum with large, shallow, close punctures as in the other Canadian species. Abdominal segments, except the apical, alutaceous and with very shallow, obsolete foveae as in the allied species; last ventral segment and pygidium with a system of irregular strigae that produce a finely vermiculated sculpture, this more or less obscuring the sparse punctures of the pygidium. Each anterior tibia of the male with two equal, spur-like processes on the inner side at apex, these separated by a U-shaped space; each middle tibia with a single process; the tibiae of the female lacking processes.

Aedeagus (fig. 2) much as in *comptoniae*, *chamaedaphnes*, and the holotype of *bebbianae* but with the scarcely deflexed apex more bluntly pointed, the median orifice more strongly angulate anteriorly, and the flagellum more slender; the flagellum 59 to 67 per cent as long as the portion of the aedeagus distal to the submedian constriction, its basal orifice occupying 31 to 38 per cent of the flagellar length.

Food plants: certain species of *Rubus* L. belonging to the subgenus *Eubatus* Focke. The specimens from Kirk's Ferry were taken on a species closely allied to *R. frondosus* Bigel; those from Constance Bay occurred on one or more other species.

Holotype: ♂, Kirk's Ferry, Que., on *Rubus* (*Eubatus*) sp., May 27, 1942 (W. J. Brown); No. 5403 in the Canadian National Collection, Ottawa.

Allotype: ♀, same data.

Paratypes: 8 ♀, same data; 2 ♂, 4 ♀, same locality, Sept. 18, 1940; 31 ♀, Constance Bay, Ont., July 30, 1941, and May 9, June 7, and July 22, 1942; 23 ♀, Constance Bay, Ont., reared from larvae during July and August, 1941 and 1942. All paratypes were taken from their food plants by the author. Both localities are in the Ottawa district.

This species may be distinguished from all of the others by the vermiculated sculpture of the pygidium and apical ventral segment. It is represented in our collection by specimens, unassociated with food plants, from Riding Mountain National Park, Manitoba, and from New Jersey.

6. *Arthrochlamys plicata* (Fab.)

Clythra plicata Fabricius, 1798, Supplementum Entomologiae Systematicae, 111.

Chlamys plicata of authors, in part.

Chlamys gibbosa of authors, in part.

Boloschesis gibbosus (Fab.), Schaeffer, 1926, Proc. Ent. Soc. Washington, 28:187, in part.

Larger than any of the Canadian species, the males measuring from 4 to 4.3 mm., the females from 4 to 4.8 mm. Rather strongly shining; color variable, bronze or copper-colored, the elytra in four of the nineteen specimens almost entirely dark blue; the underside and legs of all specimens with numerous areas showing bluish or purple reflections; antennae entirely yellow; labrum and a spot within the emargination of each eye yellow. Pronotum as in *bebbianae*. Elytra with the tubercles, including the juxta-scutellar, a little more strongly developed than in the other species; the strigulose sculpture extremely fine and poorly defined as in *alni*. Prosternal plate similar to that of the allied species but modified in the male; the portion between the middle coxae with the sides strongly elevated and finely and deeply serrate in that sex. Punctures of the metasternum very close, extremely large and shallow, their margins not as well defined as in the other species. Abdomen roughened by large, scarcely defined foveae; the sculpture of the apical segment like that of the first segment, not deeper, rougher, and less coarse as in the Canadian species. Pygidium alutaceous

and sparsely punctate. Each anterior tibia of the male with two spur-like processes on the inner side at apex, these approximate as in allied species, the posterior process much shorter than the anterior; each middle tibia with a single process; the tibiae of the female lacking processes.

Aedeagus (fig. 3) with the apex almost squarely truncate; the extreme apex feebly deflexed and clothed with short, close, golden hairs that are difficult to observe and not at all evident in balsam mounts; flagellum slender, its length equaling 67 to 69 per cent of the length of the portion of the aedeagus distal to the submedian constriction, its basal orifice occupying 28 to 31 per cent of the flagellar length.

Food plant: blackberry.

The species is represented in the collections by four males and fifteen females from Florence, Georgetown, Clemson College, Meredith, Mt. Pleasant, Pisgah Forest, and Gable, S. C., Clayton, N. C., and Payne County, Okla. The five specimens from Florence were reared on blackberry by Mr. O. L. Cartwright; the elytra are bronze in four of these but are dark blue, with bronze areas along the margins, in the other. Those from Clemson College include the males described above; they were collected on blackberry by Mr. Cartwright.

7. *Arthrochlamys alni* n. sp.

Known from females only. Length 3.7 to 4.1 mm. Body dull above because of the feebly shining elytra; bronze, the color constant; with or without a yellow spot within the emargination of each eye. Pronotum as in *bebbianae*. Elytra with the tubercles, including the juxta-scutellar, well developed; the strigulose sculpture as in *plicata*, finer and more poorly defined than in the other species. Each anterior and middle tibia with a small, inwardly projecting, spur-like process as in females of *bebbianae* and *chamaedaphnes*. Other characters as in *bebbianae*.

Food plant: the speckled alder, *Alnus incana americana* Regel.

Holotype: Norway Bay, Que., on *Alnus incana americana*, Aug. 30, 1942 (W. J. Brown); No. 5404 in the Canadian National Collection, Ottawa.

Paratypes: 40, same data; 9, same locality, Sept. 3, 1940, (G. A. Hobbs); 5, same locality, reared from pupae, August and September, 1942; 12, Blackburn, Ont., June 3 and 12, Aug. 20 and 28, Sept. 5 and 13, 1940 to 1942; 6, Blackburn, Ont., reared from larvae and pupae, August, 1942; 2, Merivale, Ont., May 8, 1941, and July 20, 1942; 2, South March, Ont., June 12, 1941; 1, South March, Ont., reared from larva, June and July, 1941; 6, Arnprior, Ont., May 11, 1941, and Aug. 2, 1942; 3, Arnprior, Ont., reared from larvae and pupae, August, 1942; 1, Ottawa, Ont., reared from larva, August, 1942; 2, Brome, Que., May 31, 1936; 5, Quyon, Que., May 24, 1935; 1, Hull, Que., Aug. 14, 1942; 1, Hull, Que., reared from pupa, August, 1942; 1, Bathurst, N. B., reared from larva, 1939.

All paratypes were taken on *Alnus incana americana*, and all except those taken by Mr. Hobbs were taken by the author.

8. *Arthrochlamys bebbianae* n. sp.

Length of males 3.3 to 3.6 mm., of females 3.5 to 4.0 mm. Nearly always bicolored; holotype and most of the paratypes with the body, except for the elytra, copper-colored; areas of the pronotum, especially posteriorly, of the sides of the body beneath, and of the legs, with purplish reflections; the elytra deep purple and quite dull; some of the paratypes lacking purplish reflections on the anterior and lower parts of the body; some with the elytra paler purple or deep blue; three of the reared females entirely bronze; two reared females bronze but with areas of the elytra showing purple reflections; a spot within the emargination of each eye, each antenna in at least basal half, and the labrum yellow, the spot of the emargination sometimes obscure, the apical halves of the antennae usually dark. The gibbosity of the pronotum moderately deeply divided as in

all species except *cribripennis*; its form as in *alni*, *plicata*, and some specimens of *chamaedaphnes*, slightly narrower than in the other species in its cephalic aspect; strigose sculpture of the pronotum as in *alni* and *plicata*, a little more irregular than in *chamaedaphnes*, a little finer than in the other species; pronotal punctures sparse, coarse but very feebly impressed, usually quite distinct. Elytra with the tubercles well developed, the juxta-scutellar well developed in the holotype and most of the paratypes but feeble in many specimens; the strigulose sculpture quite evident, as in *chamaedaphnes*, a little finer than in *eubati* and *comptoniae* and a little better developed than in *alni* and *plicata*.

Prosternal plate goblet-shaped. Punctures of the metasternum very large and close, shallow but well defined. Abdomen with very shallow, poorly defined, more or less confluent foveae which vary considerably in number on the first segment; the sculpture of the apical segment usually less coarse, deeper, and rougher than that of the first. Pygidium punctate and alutaceous. Each anterior tibia of the male with two equal, approximate, spur-like processes and each middle tibia with a single process as in most of the other species; each front and middle tibia of the female with a single similar process as in *alni* and *chamaedaphnes*.

Aedeagus of two forms; that of the holotype (fig. 4) and most of the male paratypes with the extreme apex feebly deflexed, the acute apical angle quite evident in the dorsal aspect; anterior margin of the median orifice feebly or only moderately strongly angulate; flagellum slender, its width equal to one-sixth or one-seventh of its length, its length equaling 55 to 63 per cent of the length of the portion of the aedeagus distal to the submedian constriction; basal orifice of the flagellum occupying 30 to 36 per cent of the flagellar length. Aedeagus of the morphotype (fig. 5) and several of the paratypes differing in having the apex not deflexed, broadly rounded, not produced greatly beyond the margin of the median orifice; the flagellum very stout, its width equal to a trifle more or less than one-fifth of its length, its length equaling 48 to 58 per cent of the length of the portion of the aedeagus distal to the submedian constriction; basal orifice of the flagellum large, occupying 46 to 61 per cent of the flagellar length.

Food plant: a willow, *Salix Bebbiana* Sarg.

Holotype: ♂, Arnprior, Ont., reared from larva taken on *Salix Bebbiana* in August, 1942 (W. J. Brown); No. 5405 in the Canadian National Collection, Ottawa.

Morphotype: ♂, same data.

Allotype: ♀, same data.

Paratypes: 5 ♂ resembling the holotype, 2 ♂ like the morphotype, 12 ♀, Arnprior, Ont., reared from larvae and pupae during August and September, 1942; 2 ♂ like the holotype, 7 ♀, Arnprior, Ont., Aug. 2 and Sept. 7, 1942; 2 ♂ like the holotype, 6 ♀, Blackburn, Ont., Sept. 13, 1942; 3 ♀, Blackburn, Ont., reared from pupae during August and September, 1942; 1 ♂ like the holotype, 1 ♂ like the morphotype, 3 ♀, South March, Ont., Sept. 18, 1942; 5 ♂ like the holotype, 2 ♂ like the morphotype, 9 ♀, Merivale, Ont., reared from larvae and pupae during August and September, 1942, 6 ♂ like the holotype, 2 ♂ like the morphotype, 5 ♀, Merivale, Ont., Aug. 17 and 31, Sept. 3 and 11, 1942; 1 ♂ like the holotype, 2 ♀, Hull, Que., reared from pupae, August, 1942. All localities are situated in the Ottawa district; all specimens were collected or reared by the author, and all were taken on *Salix Bebbiana* Sarg.

In several of the paratypes, the elytra are not quite contiguous for a short distance behind the scutellum, and in a few of these the metascutellum is visible. Of the seventy-nine specimens, forty-eight are females and thirty-one are males. In the males the aedeagus is typical in twenty-three and atypical in the morphotype and seven other individuals. In none is the aedeagus intermediate in its characters. The beetles with different types of aedeagi are in-

separable by other characters; they occur together, and they similarly restrict their feeding to *Salix Bebbiana*. For these reasons, I am considering them, tentatively, forms of a single dimorphic species. Darlington (7) has given reasons why such dimorphism may occur in the genitalia of insects.

9. *Arthrochlamys chamaedaphnes* n. sp.

Strongly shining; the body, including the elytra and legs, shining much more strongly than in most specimens of *bebbianae*. Pronotum with the punctures less distinct and the strigulose sculpture more regular than in *bebbianae*. Usually differing in color from *bebbianae*. Males differing from those of all the other species in having only one spur-like process on the inner side of each anterior tibia at apex, the process like that of each middle tibia; each anterior and middle tibia of the females with a smaller spur-like process as in *alni* and *bebbianae*. Other characters much as in *bebbianae*.

Length of males 3.2 to 3.6 mm., of females 3.5 to 3.8 mm. Copper-colored; the holotype and most of the paratypes with a strong reddish cast, this sometimes feeble or lacking, sometimes deepening on the elytra to dark purple, thus producing specimens inseparable by color from average specimens of *bebbianae*. Pronotum as noted above and in the description of *bebbianae*. Elytra as in *bebbianae*. Abdomen nearly always less strongly roughened than in *bebbianae*. Aedeagus as in the holotype of *bebbianae*.

Food plant: the leather leaf, *Chamaedaphne calyculata* (L.) Moench.

Holotype: ♂, South March (near Ottawa), Ont., on *Chamaedaphne calyculata*, Sept. 19, 1942 (W. J. Brown); No. 5406 in the Canadian National Collection, Ottawa.

Allotype: ♀, same data.

Paratypes: 31 ♂, 42 ♀, same data; 1 ♂, 1 ♀, same locality and food plant, Sept. 18, 1942 (J. McDunnough).

The form of the pronotal gibbosity varies not greatly but more than in the other species. In most of the specimens it is a trifle wider, in its cephalic aspect, than in any of the specimens of *bebbianae*, *alni*, and *plicata*, resembling, in this respect, *comptoniae*. The species occurs also in the Mer Bleue, a sphagnum bog near Blackburn, Ottawa district, Ontario.

LITERATURE CITED

1. Achard, Julien. Chlamydinae and Sphaerocharinae. Genera Insectorum, fasc. 160, 1914.
2. Beutenmuller, W. Food habits of some Chrysomelidae. Ent. Amer., 6:175, 1890.
3. Briggs, E. M. The life history of case bearers: 1. *Chlamys plicata*. Cold Spring Harbor Monographs, 4:3-12, 1905.
4. Brisley, H. R. Notes on the Chrysomelidae of Arizona. Trans. Amer. Ent. Soc., 51:168, 1925.
5. Bruner, L. Insects injurious to young trees on tree claims. Nebraska Agr. Expt. Sta. Bull. 14, pp. 80-83, 1890.
6. Chagnon, G. Contribution a l'étude des Coléoptères de la Province de Québec. Le Nat. Canad., 64:228, 1937.
7. Darlington, P. J. The American Patrobini. Ent. Amer., 18:141, 1938.
8. Dimmock, A. K. The insects of *Betula* in North America. Psyche, 4:283, 1885.
9. Dugès, Eugène. Métamorphoses de l'*Exema dispar*. Ann. Soc. Ent. Belgique, 25:5-7, pl. 1, fig. 1-16, 1881.
10. Fletcher, J. 16th Ann. Rept. Ent. Soc. Ontario (1885), p. 10, 1886.
11. Girault, A. A. A note on *Chlamys plicata* Fabricius. Ent. News, 22:114, 1911.
12. Hamilton, J. Catalogue of the Coleoptera of southwestern Pennsylvania, with notes and descriptions. Trans. Amer. Ent. Soc., 22:370, 1895.
13. Harrington, W. H. Notes on a few Canadian Coleoptera. 25th Ann. Rept. Ent. Soc. Ontario (1894), p. 48, 1895.
14. Harris, T. W. A Report on the Insects of Massachusetts Injurious to Vegetation. Cambridge, p. 109, 1841.
15. Leonard, M. D. A list of the Insects of New York. Cornell Univ. Agri. Expt. Sta. Memoir 101, p. 463, 1928.
16. Lugger, O. Beetles injurious to fruit-producing plants. Minnesota Agr. Expt. Sta. Bull. 66, 222, 1899.

17. Morris, F. J. A. Chrysomelians of Ontario. 44th Ann. Rept. Ent. Soc. Ontario (1913), p. 88, 1914.
18. Packard, A. S. Fifth Rept. U. S. Ent. Commission. Washington, pp. 205, 511, 599, 635. 1890.
19. Phipps, C. R. Blueberry and huckleberry insects. Maine Agr. Expt. Sta. Bull. 356, p. 129, 1930.
20. Pierce, W. D. The dune case-bearer beetles of the genus *Exema*, with a review of the genus. Bull. Southern California Acad. Sci., 39:6-27, 1940.
21. Popenoe, A. M., and C. L. Marlatt. The sycamore leaf beetle, *Chlamys plicata* Fab. Rept. of Dept. Hort. and Ent., extracted from First Ann. Rept. Kansas Expt. Sta. for 1888, pp. 40-41, pl. 1, fig. 1-8.
22. Riley, C. V. Sixth Ann. Rept. on the Noxious, Beneficial, and other Insects of the State of Missouri. Jefferson City, pp. 128-129, 1874.
23. Scudder, S. H. The early stages of three Coleoptera. Psyche, 6:174-175, 1891.
24. Smith, J. B. Insects of New Jersey. Ann. Rept. New Jersey St. Mus. for 1909, p. 340, 1910.

SOME NEW SPECIES OF *TYPHLOCYBA* (HOMOPTERA, CICADELLIDAE) *

BY R. H. BEAMER,

University of Kansas, Lawrence, Kans.

Typhlocyba spinosa n. sp.

Resembling *T. gillettei* but somewhat larger. Two inner pairs of processes of aedeagus of about same length with inner pair not bent at middle and dorsal spine as long as shaft is wide. Length 4.5 mm.

Color: As in heavily marked *T. gillettei* V. D.

Genitalia: Last ventral segment of female about three times as long as preceding; lateral angles broadly rounded; posterior margin strongly produced on median third. Aedeagus in dorsoventral view with three pairs of apical processes, outer pair longer, widened on outer third; inner pairs about one-fourth shorter, almost same length, slightly turned in at apices; in lateral view dorsal margin near apex with heavy forward curving hook about as long as width of shaft at its base.

Holotype male, *allotype* female, and 8 female *paratypes*; Sloss, Colo., Aug. 17, 1929, R. H. Beamer. Swept from huckleberry.

Fig. 1, Dorsoventral view of tip of aedeagus; 1a, Lateral view of same.

Typhlocyba nigricephala n. sp.

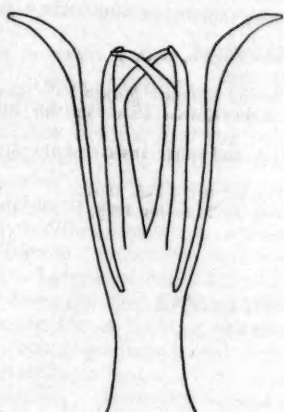
Resembling *T. hubbardi* (McA.) but black spot on outer half of elytra with anterior margin almost straight, male plates dark instead of stramineous, first pair of lateral processes on aedeagus more than half as long as shaft and apical pair very short and slightly curved in. Length 2.5-3 mm.

Color: Head, pronotum, and scutellum black or very dark brown except pair of light spots on margin. Elytra milky white except a dash each side of scutellum and posterior half from just before apex of clavus to tip, black. This latter spot with a cluster of lighter areoles about apex of clavus and others scattered about cross veins and in apical cells. Venter light except anterior portion of front, male plates, and female pygofer which are dark.

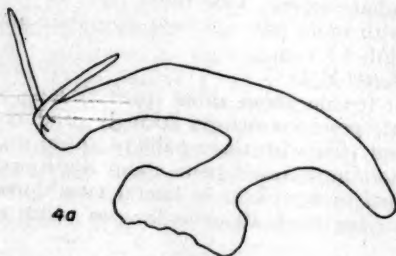
Genitalia: Last ventral segment of female about twice as long as preceding, lateral angles rounded, posterior margin sinuately produced throughout. Last ventral segment of male slightly longer than preceding, posterior margin in form of two rather evenly rounded lobes, notch between them about same size as one of lobes but sharper angled. Plates as wide at base as preceding seg-

*Contribution from the Department of Entomology, University of Kansas, Lawrence.

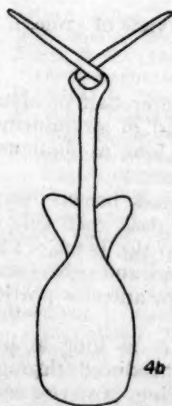
PLATE XI

1. *T. spinosa*

1a

2. *T. nigricephala*

4a

3. *T. hubbardi*

4b

4. *T. furcata*SPECIES OF *TYPHLOCYBA*

ment, narrowed on basal third, widened again at middle to basal width, then sharply narrowed to about one-third middle width, and curving dorsally to apex. Styles with foot-shaped apices. Aedeagus in dorsoventral view with shaft slightly wider apically, with two pairs of lateral processes, the first pair retrorse, more than half as long as shaft; the anterior pair very short and sharp, curving slightly in at apex.

Holotype male, *allotype* female, and numerous *paratypes*; Orange Co., Texas, Aug. 14, 1928, R. H. Beamer. These specimens were swept from a vine or creeper growing over trees in low, swampy places. Additional specimens are at hand from Arizona which agree with this species except they are much larger.

Fig. 2, Dorsoventral view of tip of aedeagus.

***Typhlocyba hubbardi* (McA.)**

Erythroneura hubbardi McAtee, Fla. Ent., 8:35, 1924.

Typhlocyba hubbardi (McA.), Beamer, Can. Ent., 66:18, 1934.

Genitalia: Posterior margin of segment preceding plates notched on median third about one-third distance to base. Plates stramineous, with outer margins parallel for about two-thirds their length, then sharply narrowed to one-third basal width and bent dorsally at right angles. Styles with foot-shaped apices. Aedeagus in dorsoventral view slightly narrowing toward tip, with two pairs of lateral processes near apex; first pair projecting backward parallel with shaft, about one-third as long as shaft; outer pair shorter, projecting forward and curved outward; apex of shaft beyond processes slightly enlarged.

Numerous specimens are at hand from southern Arizona.

Fig. 3. Dorsoventral view of tip of aedeagus.

***Typhlocyba furecata* n. sp.**

Resembling *Typhlocyba commissuralis munda* McA. but head much blunter, dorsum with fuscous markings, pygofer with apex bifurcate, and tip of aedeagus with one pair of apical processes. Length about 4 mm.

Vertex quite rounded, forming almost a semicircle.

General color stramineous. Elytra with clavus and area on costal margin deeper yellow, with subhyaline area in between more or less bordered with fuscous, occasionally this dark area extending as a band across pronotum.

Genitalia: Last ventral segment of female at least three times as long as preceding, lateral angles rounded, posterior margin so produced at middle that length on median line is almost twice that at lateral margin. Male pygofer extremely narrowed on outer half, bifid at apex. Aedeagus in dorsoventral view bulbous at base, shaft very narrow, with a pair of narrow, crossed processes at apex.

Holotype male, *allotype* female; one male and three female *paratypes*; Stinson Beach, Calif., Aug. 15, 1938, R. H. Beamer. Three female *paratypes*, Monterey, Calif., July 22, 1935, R. H. Beamer.

Fig. 4. Lateral view of tip of abdomen showing bifurcate pygofer; 4a, Lateral view of aedeagus; 4b, Dorsoventral view of aedeagus.

***Typhlocyba gillettei oregonensis* n. subsp.**

Runs out in McAtee's key (Proceedings of U. S. National Museum, p. 25, 1926) to couplet 10 but has no dark markings on the head, pronotum, or scutellum, and the elytra are dark except for a dash near apex of scutellum, a spot on apex of clavus, costal margin either side of costal plaque, and another spot covering portions of cells M_2 and M_4 which are subhyaline.

Holotype male and *allotype* female; 3 male and 3 female *paratypes*; Dixie, Oregon, July 8, 1931, R. H. Beamer; 2 male and 6 female *paratypes*; Haines, Oregon, July 10, 1931, R. H. Beamer. Types in the Snow Entomological Collection.

NEW DESCRIPTIONS OF LARVAE OF FOREST INSECTS,
VI, *SEMIOTHISA*, *PARAPHIA*, *PROTOBOARMIA*
(LEPIDOPTERA, GEOMETRIDAE)*

BY. W. C. MCGUFFIN,
Ottawa, Ontario

Semiothisa granitata Gn. †
(Pl. XII, Fig. a)

Egg: Ovate in shape, bluish green in colour, the surface divided by reticulations into small hexagonal areas. Laid singly on the needles of host tree.

First Instar: Head width 0.23 mm. Body 2.0 mm. in length and 0.23 mm. in width. Brownish green body with light brown head.

Second Instar: Head width 0.5 mm. Body 4.6 mm. in length and 0.5 mm. in width. Body lined alternately with green and light green stripes. Spiracular line greenish white. Head brownish green.

Third Instar: Head width 0.9 to 1.1 mm. Body 8 to 11 mm. in length and 1.0 mm. in width. Ground colour of body light green. Middorsal line light green edged with gray. Addorsal line light green, edged with gray and separated from middorsal by a fine white line. Subdorsal line light green edged with dark gray or black lines. Spiracular line white or greenish white, ending on anal proleg. Midventral line light green with light gray edging lines. Subventral line light green with gray edging lines. Head is light brownish green with brown herring-bone markings passing over the vertex apparently as a continuation of the subdorsal line.

Fourth Instar: Head width 1.2 to 1.4 mm. Body 10 to 11 mm. in length and 1.2 to 1.5 mm. in width. Body and head coloured in much the same way as in last instar; markings usually more definite. Epicranial index 0.8 to 1.0. Distance between ocelli 1 and 2 one and a half times that between ocelli 2 and 3. Crochets on ventral proleg number 17 to 24.

Fifth Instar: Head width 1.6 to 2.1 mm. Body 16 to 22 mm. in length and 1.6 to 2.5 in width. Subcylindrical in shape. Integument of body smooth. Ground colour green. Middorsal line dark or brownish green; addorsal line green or whitish green. Subdorsal line white bordered laterally by a greenish black line, fading out on seventh abdominal segment. (This dark line corresponds to the lateral line of Dyar). Supraspiracular line green; spiracular line light green. Sometimes dark bands cross the supraspiracular and spiracular lines in the vicinity of the spiracles on abdominal segments 1 to 5. Subspiracular line green. Midventral stripe green. Adventral line fine, white. Subventral line geminate, dark gray, running between the metathoracic legs and the prolegs. Anal area green or purplish. Head smooth, the ground colour greenish brown. A dark chestnut-brown band runs down either side of head from vertex to base of frons; in some specimens, this dark colour may occupy whole of vertex. There may also be dark herring-bone markings along the epicranial stem. Ocellar area light. Adfrontals light green with slightly sinuate adfrontal sutures. Frons light green to rosy. Epicranial index 0.8 to 1.1. Distance between ocelli 1 and 2 from $1\frac{1}{2}$ to 2 times that between ocelli 2 and 3. Postclypeus light green to rosy or light brown; preclypeus dirty white. Labrum light brown, deeply cleft at a right angle. Prothoracic shield green with middorsal line crossing it. Anal shield evenly rounded, green, with about 24 brown punctures arranged roughly in three groups. Setigerous tubercles consisting of brown papillae set directly on the integument; setae long, brown and conspicuous. Spiracles oblong-elliptical

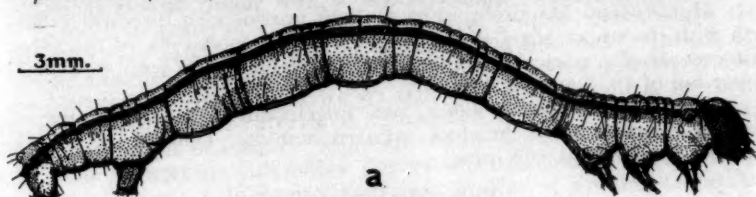
*Contribution No. 2177 from the Division of Entomology, Science Service, Department of Agriculture, Ottawa. This is the sixth of a series of contributions from the Canadian Forest Insect Survey.

†H. G. Dyar, in *Psyche*, 11:105, 1904, described the form of this larva found in British Columbia.

PLATE XII



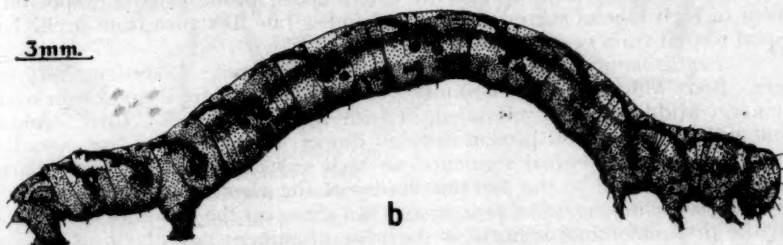
3mm.



a



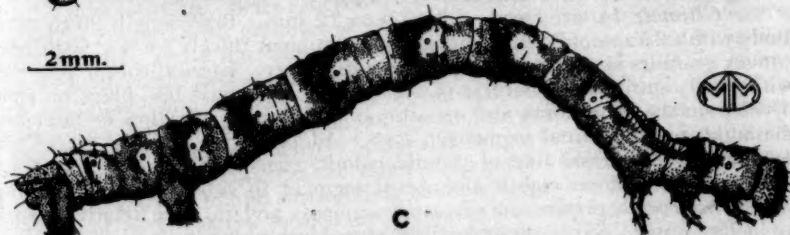
3mm.



b



2mm.



c

LARVAE OF FOREST INSECTS

- a, Larva of *Semiothisa granitata* Gn. (sixth instar).
 b, Larva of *Paraphia piniata* Pack. (ultimate instar).
 c, Larva of *Protoboarmia porcelaria indicataria* Wlk. (sixth instar).



in shape with light brown centres and brown rims. Thoracic legs light green, brown distally or rosy, purplish distally. Prolegs greenish or purplish; each ventral proleg with 24 to 28 crochets and each anal leg bearing a lateral plate, dotted with a few brown punctures.

Sixth Instar: This instar is not always present; most larvae pupate directly from the fifth stage. Larvae of this instar closely resemble full-grown larvae of the last instar.

Mouthparts: Mandibles (Fig. a) light brown, with three ridges and nine teeth with the upper edges slightly crenulate. Hypopharynx of the usual type. Spinneret slender, conical and pointed at tip; labial palpi with segments in the proportion of 10, 3 and 10.

Food Plants: White, black, red, Engelmann and Sitka spruce; balsam, tamarack, western larch, hemlock, western hemlock, Douglas fir, alpine fir, Amabilis fir, red and jack pine.

***Paraphia piniata* Pack.**

(Pl. XII, Fig. b)

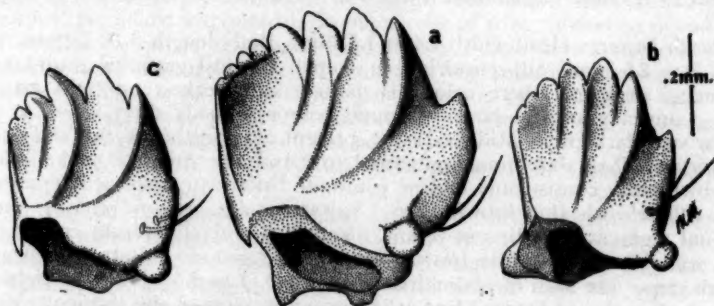
Early Instar: The larvae have no dark obliques on the body.

Antepenultimate Instar: Head width 1.2 mm. Body length 7 to 11 mm. Body width 1.2 mm. Ground colour yellow. Middorsal line yellow, containing a pair of ruddy brown lines. Between this line and the spiracular line are fine, ruddy brown lines, graying near the spiracles. On the first abdominal segment is a pair of dark obliques running from the middorsal line downwards and forwards to the spiracular line, which latter line is yellow and present only on abdomen. Head yellow with ruddy brown spots; prominent light spot on the front of each lobe of vertex. Epicranial index 1.0. Distance from ocelli 1 to 2 equal to that from ocelli 2 to 3.

Penultimate Instar: Head width 1.3 to 1.5 mm. Body length 10 to 17 mm. Body width 1.5 mm. Ground colour yellow with ruddy suffusion towards venter. Middorsal line yellow edged with fine ruddy brown lines. Addorsal line gray, geminate and present only on thorax. Dark obliques on metathorax and first eight abdominal segments; on each segment these run from the middorsal line forward to the anterior border of the segment; the obliques on the anterior segments are more prominent than those on the posterior, and the one on the first abdominal segment is the most prominent one of all. In the subdorsal area, on the eighth abdominal segment, is a small white or yellow spot. Spiracular area yellow, with gray patches around the spiracles. Venter marked like dorsum but lighter in colour and lacking obliques. Ground colour of head is yellow with brown spots scattered in certain areas: above and laterad of vertical seta 1, sides of the head and lower part of head including the ocellar area and postclypeus. There remains, in the middle of the face, a light, rectangular area which includes the frons. Across this light patch runs a dark bar. Epicranial index is 1; distance between ocelli 1 and 2 equal to that between 2 and 3. Crochets on ventral proleg number 14 to 27.

Ultimate Instar: Head width 2.0 to 2.2 mm. Body length 20 to 27 mm. Body width 2.5 mm. Body cylindrical. Integument thickly covered with minute convex granules arranged to give rugose appearance. Ground colour pale yellow with ruddy suffusion at borders of segments. Middorsal line black on thorax, divided on the mesothorax and metathorax and a series of yellow or light brown diamonds on abdominal segments 1 to 8. Addorsal line reddish, grayed above setae beta. Subdorsal line of ground colour, edged with gray or black lines; light spot present on eighth abdominal segment in subdorsal area. Obliques very conspicuous, present on the same segments and in same relative positions as in last instar. Supraspiracular line gray, black above spiracles. Integument folded in subspiracular area. Venter of ground colour with ruddy brown lines. The light midventral line is edged with fine dark alternating dashes and brackets.

Positions of setae marked by dark spots, the one at sigma being very prominent. Head rugose, coloured as in last instar. Adfrontals light at ends, dark in middle, sutures almost straight. Frons light purple or brown with a brown spot in each basal corner. Epicranial index 1.0. Postclypeus brown and preclypeus dirty white. Labrum light brown and moderately notched at an angle of 100 degrees. Distance between ocelli 1 and 2 equal to that between ocelli 2 and 3. Prothoracic shield ground colour with brown markings. Anal shield, evenly and bluntly rounded at posterior end, pale yellow with gray or brown edges; there is an irregular gray patch at the end of the middorsal line and frequently light arcs curving outward from the subdorsal lines; many yellow pits are scattered over the surface. Setigerous tubercles are flat, dark brown papillae set directly on the integument. Each tubercle is surrounded by, first, a light ring and, second, a dark patch of colour. Setae are short, light and inconspicuous. Spiracles oblong-elliptical, with yellow centres and dark brown rims. Thoracic legs of ground colour with brown markings; prolegs of ground colour with brown markings, frequently with rosy suffusion; ventral proleg bearing 25 crochets.



a, Mandible of *Semiothisa granitata* Gn.
b, Mandible of *Paraphia piniata* Pack.
c, Mandible of *Protoboarmia porcelaria indicataria* Wlk.

Mouthparts: Mandibles (Fig. b) brown, with three or more ridges and eight teeth. Hypopharynx of the usual type, with spinneret conical and rounded at tip and labial palpi with segments in the proportion of 7, 3 and 14.

Food Plants: White, black and Engelmann spruce; also tamarack, balsam, hemlock, white cedar; jack, white, lodgepole and Scots pine; white birch.

***Protoboarmia porcelaria indicataria* Wlk. ***

(Pl. XII, Fig. c)

Second Instar: Head width 0.60 mm. Body 4.0 mm. in length and marked in much the same way as in next stage.

Third Instar: Head width 0.72 mm. Body 6.0 to 8.0 mm. in length and 0.8 to 1.0 mm. in width. Body subcylindrical, widest at sixth abdominal segment. Integument covered with granules of two types: numerous attenuated, retrorse, conical granules, and a few convex granules. Ground colour varies from dirty white to light ruddy brown. Middorsal line gray or black, present on thorax, ninth abdominal and anterior half of abdominal segments 1 to 8 and 10. Adorsal line lighter than middorsal; subdorsal line gray (white and prominent on the thorax of dark specimens). Spiracular line appears yellow on first and second abdominal segments; on the other abdominal segments it is a series of light patches anterior to and surrounding the spiracles; posterior to the spiracles is a series of dark patches formed by the protuberances bearing setae kappa.

*In Technical Bulletin 31, Dept. Agr. Can., pp. 10-11, the eastern form has been characterized as *P. porcelaria* and the western form as *P. porcelaria indicataria*. I have been requested by the author of this bulletin to state that these may now be considered as one form, extending across Canada from coast to coast.

Midventral line is broken, gray, flanked by light stripes; remainder of venter gray with broken dark gray lines. Head dirty white with brown herring-bone markings on genae. From the subdorsal lines on the thorax, a light streak runs over each lobe of the vertex down along the adfrontals to the articulation of the mandibles. Prothoracic shield of ground colour with dark middorsal line and brown markings. Anal shield smoothly rounded, ground colour with small dark gray punctures. Setigerous tubercles consisting of dark brown papillae set either directly on the integument or on minute convex pinacula. Protuberances bearing setae kappa and sometimes those bearing setae pi brown or black; setae light brown and conspicuous. Spiracles have dark brown rims and light centres. Thoracic legs and prolegs ground colour with dark markings.

Fourth Instar: Head width 1.0 to 1.1 mm. Body 9 to 13 mm. in length, 1.2 to 1.5 mm. in width. Retrorse conical granules not so attenuated as in previous instar. Epicranial index 0.9 to 1.4; distance of ocelli 1 from 2 equal to that from ocelli 2 to 3. (These distances are also equal in the following instars). Crochets on ventral proleg number 22.

Fifth Instar: Head width 1.2 to 1.3 mm. Body length 8 to 17 mm. Body width 1.2 to 1.5 mm. Epicranial index 1.0. Crochets of ventral proleg number 30 to 32.

Sixth Instar: Head width 1.4 to 1.5 mm. Body length 8 to 25 mm. Body width 1.2 to 2.5 mm. Subcylindrical in shape. Conical granules abundant on integument; strongest where colour is darkest and weakest on light areas of venter. Convex granules scarce. Ground colour of body dirty white to gray brown or very dark gray. Middorsal line, present only on thorax, 9th abdominal, and anterior half of abdominal segments 1 to 8 and 10. Addorsal and subdorsal lines brown; may consist only of fine geminate lines. Supraspiracular area of ground colour with fine brown lines. Spiracular line ground colour; on 1st abdominal segment, this line is yellow. Venter slightly lighter in colour than dorsum and bears many fine brown lines on the ground colour. Midventral line dark gray. On each of abdominal segments 3, 4 and 5, there is a light rectangular bar on the midventral line at the posterior edge of the segment. Vertex of head is covered with contiguous convex granules. Ground colour of dirty white to gray brown; purplish or brown markings are noticeable, especially on apices of vertex and on the streak running from each ocellar area up to the adjoining apices; an indication of herring-bone markings along the epicranial stem. Front of head light; ocellar area light. Adfrontal suture wavy, not distinct. Frons largely brown or purplish. Epicranial index 0.7 to 1.4. Postclypeus concolorous with frons; preclypeus dirty white. Labrum brown, shallowly notched at an angle of 90 degrees. Prothoracic shield of ground colour with brown markings; anal shield evenly rounded, ground colour with coarse brown punctures. Setigerous tubercles consisting of dark brown papillae set on small convex pinacula; on abdominal segments 1 to 5 the tubercles bearing kappa and pi setae are borne on large black or brown protuberances set with conical granules and those bearing eta setae are borne on protuberances which may be white, yellow or of ground colour, also set with conical granules. Spiracles oblong-elliptical in shape, have light brown centres and heavy brown rims. Thoracic legs of ground colour with dark markings. Prolegs of ground colour; ventral prolegs bear about 30 crochets and each anal proleg bears a lateral plate set with brown pits.

Overwinters as larva in fourth, fifth or sixth instar.

Mouthparts: Mandibles (Fig. c) light brown, with two main ridges and seven teeth: the first tooth is reduced, being represented only by a slight bulge. Hypopharynx of the usual type; spinneret subcylindrical, rounded at the tip and labial palpi with segments in the proportion of 10, 3, and 10.

Food Plants: White, black, red, Engelmann spruce; balsam, tamarack, western larch, Douglas fir, alpine fir, hemlock, western hemlock, white cedar, western cedar; white, jack, red, Scots and lodgepole pine; poplar, yellow birch and bur oak.

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